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REPORT

ON THE

System of Water Supply

OF

ST. JOHN, N. B.

BY

A. FTELEY,

Consulting Engineer.

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NEW YORK, October 1, 1884.

To His Worship, J. McGregor Grant, Mayor of St. John, N. B., and to the Special Committee on Water Supply of the Common Council:

GENTLEMEN :

This report is written in obedience to the following instructions given by His Worship :

ST. JOHN, N. B., 7th July, 1884.

A. FTELEY, Esq., C. E.

Dear Sir :

"The duties which the Special Committee of Water Supply of the Common Council of this City require from you are :

1st. A brief report on the present system of water supply to this city, stating its advantages and defects.

2d. A report on the best and most economical method of obtaining an increased water supply to this city, with pressure sufficient to provide for the upper portions of the city for the next ten years."

I am, dear sir,

Yours truly,

J. MCGREGOR GRANT,

Mayor.

On the 18th of June, 1884, when you requested me to examine the present system of water works of St. John, and to report on the same, you sent me, at the same time, several reports bearing on the subject and prepared by your engineers.

During my subsequent visit to St. John, in the beginning of July, I visited your works and made a personal study of their most important features.

The data used in the preparation of this report have been obtained from personal observations, from the records kept by the Water Commissioners, and from the documents sent by yourself.

As it would be difficult to attempt at once to answer *seriatim* the comprehensive questions contained in the instructions quoted above, without entering into explanations which might lead to some confusion, on account of their common bearing on the various points involved, I may be permitted to review, at first, the condition of your system of works in a general manner. The various points to which you called my attention will be kept in view, and I propose to reserve for the conclusion of this report the direct answers, which will be more easily understood in the light of the explanations previously given.

Without reviewing at length the interesting history of the growth of your system of water works, well known to you and to the citizens of St. John, and fully given in your public records, it may not be out of place to recall the fact, so rare in the development of cities, that St. John, after recognizing the inadequate facilities of its original pumping works in connection with Lily Pond, adopted at the start the policy of planning its system of water works, for the future as well as for the present, with the idea of building it up by successive steps, as the wants of the city would require new water facilities.

The first projectors of this system did not fail to realize the excellent, even exceptional, opportunities presented by the topographical features of the water sheds of Little

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River and of Loch Lomond, and they secured at an early time the legislative authority necessary to extend the works to the latter source of supply whenever the wants of the city would require such course to be followed.

In the mean time, the works were so planned as to extend gradually towards the ultimate point of supply, stopping from time to time in their progressive course, within the actual needs of the city.

Thus were the Little River Reservoir, with the 12-inch main, the first 24-inch main, the second 24-inch main, and the connection with Lake Latimer, successively established.

A new step in the development of your system of works is now required for the main purpose of increasing the water pressure on the highest parts of the water district. This lack of pressure has always been felt on the summits of St. John (East), and is becoming every day more noticeable, on account of the increased consumption, with its consequent reduction in the general pressure, and on account of the increase of population on the high portions of Portland.

I need not add any comment on the necessity of providing a remedy for this condition of things, which deprives an important portion of your water district from the full benefit of your water supply. I only wish to call your attention to the fact that the summits of your city and of Portland are now, either partially, or wholly, unprotected in case of a large conflagration.

The water-shed of Little River, from which the greater part of your supply is drawn, is comparatively large for the population of St. John, but its storage capacity is very small. Lake Long and Lake Buck cannot be considered as storage reservoirs, and the fluctuations allowable in Little River Reservoir furnish practically the only storage which can be depended on.

Fortunately, the water-shed of Little River yields, during the dry season, a remarkably large amount of water, owing to its peculiar situation in the near proximity of extensive

bodies of water placed at a higher level, from which it probably receives a considerable supply through underground channels.

Were it not for this favorable circumstance, the watershed of Little River would have failed before this time to supply your city. You have, indeed, been obliged already to tap Lake Latimer, and to draw from it at various times of the year.

The capacity of the water-shed of Little River could be increased by building storage reservoirs capable of retaining a portion of the water which is wasted over the dam. Whether such policy is advisable will be considered later.

The three pipes from the Little River Reservoir to the Aboidean are of ample capacity to convey the amount of water consumed by the city; their location is well chosen, and their mode of connection, at a point a short distance below the reservoir, is such as to give excellent conditions of efficiency for flowing capacity and for pressure. The general arrangement of the distributing pipes is judicious, but a few of the old pipes are too small; the hilly character of the ground is the cause of the great differences of pressure observed, but the circulation of water is not impaired or retarded by the wavy form of the pipe lines, and the periodical records of pressure taken at the hydrants throughout the city show very regular results. Observations made during my stay in St. John, by day and by night, confirmed fully the indications found in the records. You called my attention to several cases of irregularities of pressures which had been reported to you, but nothing in the study of the pressure records throughout the city indicates any general defect in the arrangement of the water distribution, to which such irregularities should be attributed; their existence, if established by good evidence, must be attributed to local causes, such as an excessive consumption in the vicinity. It is possible also that some of the smallest of the old pipes may be tuberculated, and present local obstructions to the flow of water. These cases should be investigated and could be remedied.

You requested me also to visit the Leinster Street Reservoir. I found it in good order and in such condition as to render, in case of fire, all the service that it is capable of. The limits of its usefulness are well defined in the "Review of the Report of Hurd Peters, Esq., C. E., by Gilbert Murdoch, Esq., C. E., 1884," p. 39, etc., and in the diagram attached, and I can only add that this structure, very serviceable, without doubt, when connected with the small supply of former times, cannot be expected to answer purposes for which it was not designed. With the present system of water works and with the present consumption of the city, it is as serviceable as it is possible to make it.

One conspicuous feature of your water supply is the large volume consumed in proportion to the population. The daily consumption is reported as being in August, 1884, 4,327,700 gallons daily; the maximum consumption in February, was 5,595,200. I have, from the data obtained, computed the amount of consumption, and find it substantially as stated. This consumption, with a population (in 1881) of 21,563 for St. John (East) and 15,216 for Portland, in all 36,779, gives an average consumption per head of the whole population of 118 gallons in August and of 152 gallons in February.

The waste is evidently large, and the table of measured waste given in Mr. Murdoch's special report of 1883, shows that, if such cases are frequent, the excessive consumption is mainly attributable to that cause, as the general regularity of the pressures observed throughout the city, precludes the idea of local leakages in the mains. To prevent or diminish this evil, the water Commissioners should be given more authority to control the quality and sufficiency of the water fixtures.

The great need of your water system is an increase of pressure on the summits of St. John (East), and of Portland. Little River Reservoir is not at a sufficient altitude to give any adequate pressure at those points, and, were it not for the ample capacity of the main pipes conveying the water from

the reservoir to the Aboidean, which reduces the loss of head to a small figure for so long a distance, there would be more suffering than there is to-day on the highest points.

It has been suggested (and you called my attention to that point), that an increase of pressure on the summits could be obtained by the creation of reservoirs. A study of the variations of pressures on the summits shows that such reservoirs, whatever be their size, would only give a partial relief. They would undoubtedly be of great service, in case of fire, by furnishing a large and ready supply, but they would not materially increase the efficiency of the service for other purposes. If they could be built at a small cost, it would be well to give to this subject a serious consideration; but, in order to be useful, they should be of large size, and the nature of the ground on which they could be built is such that they would be very expensive. I consider the cost of such structures as entirely out of proportion with the limited advantages to be obtained from their construction, and their erection is not recommended.

Sufficient pressure cannot be obtained with the present arrangement of the work, and the great difference of altitude between the low and the high portions of the city suggests the division of the water district into a low service and a high service. The limits of the two services should be substantially as described in Mr. Murdoch's special report of 1883, and as shown on the map in his office. The low service district would continue to be supplied from the present reservoir. The greater pressure required for the high service district can be procured by two methods, which are hereafter described.

The first method, known to you, and described in Mr. Murdoch's special report of 1883, meets fully the requirements of an increase of pressure for the high portions of the city, and is in keeping with the plan followed from the inception of the system of water works; the report being in your hands, a short mention only is necessary in this connection. It consists in utilizing the higher altitude of the

surface of Loch Lomond, to bring its water directly to the city, through one of the 24 inch mains, with ample pressure for the high service district ; the Little River Reservoir furnishing at the same time, through the other main, the water necessary for the low service.

Of the several routes studied and described in the report, the route through Lake Latimer is the best, and should be selected in preference to the others, if this mode of extension of the works was selected.

Mr. Murdoch suggested that the cost of the scheme could be reduced considerably, for the present, by omitting the construction of the proposed intermediate reservoir, and by stopping the work at Lake Latimer. The purity of the water of this lake, which probably undergoes a process of natural filtration, the small extent of the apparent watershed, and the rapid rise of the surface of the lake after it has been drawn from, indicate that its supply must be large ; moreover, as the location of the proposed outlet would be thirteen feet below the present surface, the storage capacity would be considerable ; but, as all the water necessary for the high service supply would be drawn from it, some doubts must be entertained in regard to the ability of that source to furnish a sufficient supply, and to recover in the winter and spring from the heavy draft of the dry season.

I believe, however, with the author of the suggestion, that the experiment would be worth trying before extending the work as far as Loch Lomond.

This method would supply the city with an abundance of excellent water at the required pressure, and the works would be of a permanent character, but the expenditure necessary to carry them out is large.

The other method would not require, for the present, so large an expenditure, and would meet the requirements of high pressure for the summits of the city.

It consists in the erection of a pumping plant in connection with the present works.

The pumping station should be located at a point, as

equally distant as practicable, from the two principal summits of St. John and of Portland, and at such an elevation as to avoid too heavy a pressure on the supply pipe; its exact position can be fixed only after an investigation of the localities where the city could conveniently procure land, but the writer suggests as a suitable location a point in Waterloo street near Paddock street, on the boundary of the high and low service districts.

The pumping plant would include two pumping apparatus complete, with their boilers, buildings, etc., an iron stand pipe, a special supply pipe, extending to the Aboidean, and two force pipes; one, connected with the high service district of St. John (east), the other with the heights of Portland. New gates and some modifications of the position of the present hydrants and gates would be necessary for the proper handling of the water in connection with the two services.

An idea of the amount of water which should be pumped for the ordinary uses of the high service districts, can be formed from the fact that in St. John (east), 1,200 families would be supplied. If we add to it the probable consumption in Portland, the quantity to be pumped daily may be stated, approximately, to be 1,500,000 gallons. This consumption, however, should not be the measure of the capacity of the pumping plant; there being no storage in connection with the high service, the pumps must be capable of furnishing, at any moment, the maximum quantity that may be needed, *i. e.*, the amount required during the progress of an extensive fire.

For the purpose of duplicating the service for ordinary consumption for the next ten years, and of furnishing an adequate supply in case of an extensive fire, the pumps should have each a capacity of 2,000,000 gallons per day. The supply and force pipes connected with them should be 15 inches in diameter.

The introduction of higher pressures on the summits would obviously increase the consumption of water; should

the waste remain unchecked, this increase of consumption might tax your sources too heavily, and compel the city to increase the supply in time of drought.

It has been mentioned that an increase of supply could be obtained by erecting reservoirs in the water shed of Little River, but, owing to the marshy character of the land surrounding Lake Long and Lake Buck, and to the general nature of the land in the water shed, the quality of the water supply would be impaired by the adoption of such a plan ; it would be costly and cannot be recommended, when a much better supply can be procured from the higher sources. In such a case, the city should procure a larger supply by tapping Lake Latimer at a lower level, thus taking another step forward, notwithstanding the erection of the pumping apparatus, towards the ultimate consummation of the original plan.

CONCLUSION.

To sum up the preceding remarks, and in direct answer to your instructions, I beg to conclude as follows :

1st. The present system of water-works of St. John has been conceived on a rational and comprehensive plan, which has been judiciously followed from the inception of the work by gradual steps.

The Little River Reservoir, its dam and appurtenances, are in good condition.

The pipe distribution is systematic and well arranged, as shown by the observations of pressures at the hydrants, and the general disposition of the works is unobjectionable.

The quality of the water is good, although, at certain periods of the year, it is somewhat discolored.

The storage capacity of the system is not in proportion with the extent of the water shed of the source of supply.

The water is wasted in large quantities, owing probably to the fact that the Water Commissioners have not sufficient authority to regulate the water fixtures.

The water pressure is entirely inadequate on the summits of the city, where property is partially or wholly unprotected in case of fire.

2d. Of the three methods mentioned for the purpose of increasing the pressure, one, consisting of building reservoirs on the summits, is not recommended, as the incomplete results which they would procure would not be commensurate with the expenditure to be incurred.

The other two methods will be designated in the following remarks as the "gravity system" (advocated by Mr. Murdoch in his special report of 1883), and "the pumping system."

The two methods present the common feature of a division of St. John (East) and of Portland in two water districts; the high service being supplied from the upper sources or from the pumps, the lower service from Little River Reservoir.

In the gravity system, the water supplied to the high service would come exclusively from Lake Latimer or from Loch Lomond; the water supplied to the low service would come from Little River Reservoir, but could be improved, especially at the times that it is discolored, by an admixture of Loch Lomond water.

With both systems, the same expenditure would be necessary to provide new gates, new connections, and to adapt the present gates and hydrants of the high service to the new arrangement.

In both cases, the new condition of pressure in the high service district might necessitate the renewal of some parts of the old pipes and of some of the house fixtures.

Mr. Murdoch's estimate of the cost of the gravity system (by way of Lake Latimer), based on the prices of materials in St. John, and on the estimates of reliable contractors, and concurred in by the writer, is, if we omit for the present the intermediate reservoir, \$240,000.

Should Lake Latimer prove capable of furnishing for a

time the amount of water necessary for the high service, which is possible, especially within the period of time mentioned in your instructions, the cost would be reduced to \$160,000.

The pumping system, outside of the expenditure necessary for the adaptation of the pipe distribution to the new arrangement, would cost \$65,000, to which should be added, for the time that the plant would be in operation, a yearly expenditure of about \$4,500 for fuel, repairs and attendance.

The gravity system, although more costly, presents the advantage of providing, at the same time, better water, an increase of supply, and the required increase of pressure, and would constitute a permanent improvement, in keeping with the character and with the general plan of your works.

The pumping system is the most economical, which can be devised for the next ten years, *provided an increase of supply is not needed during that period*, and that necessity may be averted by a judicious reduction of the waste. But, in view of the advantages of the gravity system, in view also of the fact that the most rational way of increasing your water supply, at some future time, is to extend your works to Loch Lomond, and that, in such a case, the cost of your pumping plant would become an useless addition to your water indebtedness, I must add that the most economical method cannot, at the same time, be considered the best.

Whether an increased pressure in the high service district would bring a corresponding increase of revenue due to the introduction of new fixtures, is a question which the writer has not considered on account of his want of familiarity with the habits and with the requirements of your citizens, but it should have an important bearing on the decision to be reached. I will, however, call your attention to the significant fact that, although the number of service pipes has increased only from 3,216 to 3,893, from 1877 to the present year, the number of baths has increased from 324 to 933, and the number of water-closets from 529 to 2,518.

To your worship, to the Special Committee on water, and to your Engineer, Hurd Peters, Esq., I return my thanks for the courtesies extended, and for the facilities given in visiting St. John and its system of water-works; and I am indebted to the Water Commissioners and to their engineer, Gilbert Murdoch, Esq., for the information given both on the works and in the office, and for their unreserved readiness to supply me with the numerous data necessary for the preparation of this report. I am glad to bear witness to the excellent system followed by them in conducting the operations connected with the management of the water supply system, and in compiling the valuable records of their department.

Respectfully submitted,

A. FTELEY,

Consulting Engineer.

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